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ABSTRACT

The state-of-the-art of three technological capabilities (i.e., audio, computer, and video) is discussed and descriptions of some interesting applications in rural and small schools are provided. Audio and audiographic technologies discussed include radio and telephone as well as voice-grade telephone lines which facilitate transmission of visual information from one location to another as exemplified by teletypes and facsimile equipment. Although no examples of audio tapes were forthcoming from the current survey, examples of radio usage from Louisiana and Michigan are provided along with telephone or teleconferencing usage in Wisconsin and Montana. In the section covering computer technologies, definitions are provided for minicomputers, microcomputers, and the major educational usages (i.e., computer-assisted instruction, computer-managed instruction, and computer-based education). Projects highlighted in this section include one each in Minnesota, Delaware, Arkansas, Indiana, and Oregon. In reviewing video technologies, a distinction is made between educational television and instructional television, with discussions centering around one-way or two-way transmission, videotape and videodisc media for storing and playing video materials, interactive video or computer-assisted video instruction, and seven interesting projects. Practitioner observations concerning planning, implementing, and maintaining the utilization of technology conclude the report. (AH)

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EFFECTIVE UTILIZATION OF MICROCOMPUTERS AND OTHER TECHNOLOGY IN RURAL AND SMALL SCHOOLS

A Paper

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EFFECTIVE UTILIZATION OF MICROCOMPUTERS AND OTHER TECHNOLOGY IN RURAL AND SMALL SCHOOLS

This paper is based upon an investigation of the uses of technology in rural schools conducted by Educational Operations Concepts, Inc. (EOC), of Saint Paul, Minnesota, for the National Institute of Education (NIE). The investigation, completed in June, 1982, was summarized in a document entitled A Guide on Successful Uses of Technology in Rural Schools. The major sections of the Guide include state-of-the-art descriptions of nine technologies, practitioner observations regarding the planning, implementation and maintenance of educational technologies, and "thumb nail" descriptions of 18 interesting projects using one or more technologies in rural educational settings.

Although present usage of the term "educational technology" is synonymous in many peoples' minds with "computer usage", we would like to expand beyond to the wider range of possible technologies. Lawrence Grayson developed a useful scheme for categorizing existing educational technologies according to their capacity (audio, video, or computer) and their accessibility (used locally or over distance). Figure 1 summarizes that scheme. Although the classification was developed very recently (1981), we might suggest the following additions, reflecting the rapid advances taking place in technological development:

- Networked Microcomputers--a capability since 1981, thereby expanding their applications to information retrieval, conferencing and message delivery;
- Interactive Video--a recent merger of the capabilities of computer and videotape or videodisc;
- Two-way TV--simultaneous two-way broadcasts, teacher to classroom and classroom to teacher; and
- Teletype--an "old" technology currently used successfuly by educators.

CAPABILITY	ACCESSIBILITY			
	USED LOCALLY		USED OVER DISTANCE	
	HARDWARE	TYPICAL APPLICATIONS	HARDWARE	TYPICAL APPLICATIONS
Audio and Audiographic	Audio tapes	Stored lectures and discussions; Instructions	Radio Teletype* Telephone Dial Access Electronic blackboard Slow-scan television Facsimile	Pre-produced and edited programs; Lectures, seminars and discussions; Retrieval of audio information; Transmission of documents, still images and hand-written information Audio conferencing
Computer	Mini-computers Personal computers	Computer-assisted instruction (CAI); Computer-managed instruction (CMI); Computer-aided testing; Problem solving; Networking*	Central computers; Remote terminals; Time-shared computing	Information retrieval; Computer-assisted instruction (CAI); Computer-managed instruction (CMI); Computer-aided testing; Problem solving; Electronic message delivery; Computer conferencing
Video	Videotape Videodisc	Stored lectures and presentations Interaction instructional programs when combined with computers (Interactive Video)*	Instructional Television Fixed Service (ITFS) Cable Two-way TV* Satellites Broadcast television	Pre-produced and edited programs; Lectures, seminars and discussions Video conferencing

Figure 1. Classification of various technologies used in education.**

* Our addition

** *Source: Lawrence P. Grayson in 1982 Edition of Encyclopedia of Educational Research.*

The remainder of this paper discusses briefly the state-of-the-art of technologies and provides summary observations of practitioners regarding technology utilization.

STATE-OF-THE-ART: TECHNOLOGICAL CAPABILITIES

The state-of-the-art of three technological capabilities (i.e., audio, computer and video) is discussed and descriptions of some interesting applications of these technologies are provided.

. Audio and Audiographic Technologies

Speech has been and continues to be a primary means for instruction. Technological advances have allowed a person's voice to be recorded for subsequent replay or transmitted over distances by radio and telephone. Voice-grade telephone lines also facilitate transmission of visual information from one location to another as exemplified by teletypes and facsimile equipment.

As a medium applied to education, radio dates to the 1920's, experienced peak usage in the 1930's and 1940's, and continues today to have potential as an effective instructional tool. In some respects radio has been the forgotten medium for instruction. Two possible reasons may be offered. Instructional radio has always been largely dependent upon commercial radio for transmission. As the commercial value of radio became apparent, stations became reluctant to broadcast instructional material during morning and afternoon "prime time." The second reason often suggested for the demise of instructional radio was the inception of television. Its audio and visual capabilities attracted the attention of educators and students alike.

Although records and audio tapes have been available for educational purposes for at least 40 years, the advent of the cassette tape and cassette recorder/player

made usage inexpensive and easily accessible. High quality tapes are available with selection dependent upon usage (i.e. music or spoken word). Most commonplace uses include: book and tape combinations, tapes to accompany film strips, stand alone tape presentations, and actual classroom tapings. Self-study courses via audio tapes and records have been available during the past 30 years, particularly in the areas of language instruction.

The use of the telephone in instruction is more recent than that of radio. Conceptually, the telephone should be at least as effective as the radio, if not more so, since it is more versatile and allows interactive as well as one-way communication. In an educational setting the telephone can be as simple as a microphone and speaker with amplifiers in two locations, or as complex as a network including dozens of sites. Additional advantages lie in the ability to transmit one-way hard copy by means of the teletype and in the currently expanding area referred to as audiographics or the ability to transmit visuals and graphics.

In the conduct of the investigation, we found the use of audio technologies to be "alive and well". The use of audio tapes was found to be incidental to many projects, and hence no project illustrating its use was singled out; however, the following four projects illustrate interesting uses of radio, telephone, and teletype.

. By utilizing information provided by an Associated Press Teletype, students in grades 4 to 6 in a small Louisiana School District prepare a daily five-minute news broadcast on the single local radio station. Students form a daily news team, then gather, classify, summarize, and prepare the five minute program. Students have been motivated to improve reading and speech skills, in order to "sound good" while added interest in current events and parent interest have been unanticipated benefits.

. In another setting, community radio is being provided by way of a school's low power, FM station for a large area on Michigan's Upper Peninsula. Nearly 200

of the 300 plus students in grades 9-12, as well as other school and community persons, cooperate to provide broadcasts of local news, meetings, sporting events and public service programs. Total cost of operation per year to the school is about $2,000.

. In Wisconsin, under the auspices of an intermediate educational service agency, a telephone network is provided to 24 small rural schools plus two urban high schools and a university campus. Although major use has been for inservice and meetings, 35 students in four districts took coursework in 1981-82 with high success, and it was anticipated that 200 students in ten districts would take coursework in 1982-83.

. A similar, but statewide, project in Montana provides an audio teleconferencing network to interconnect educational providers and receivers. Educational offerings are available at levels varying from junior-senior high school to graduate courses, plus inservice coursework for K-12 teachers. In addition, statewide educational meetings are being held via the system.

. Computer Technologies

Until a few years ago, most computers found in schools were essentially terminals linked by telephone lines (on-line) to large centrally located main-frame computers that served a variety of users by means of an arrangement called time-sharing. Main-frame computers are capable of storing large amounts of information and performing complex calculations at high speeds. However, time-sharing arrangements are expensive because they require open lines to the computer. Additional problems included: downtime due to "crashes" during peak use; busy signals when attempting to access the system; long distance charges; and limited adaptability to the learning of programming itself.

Minicomputers are mid-range (in size and cost) between microcomputers and main-frame computers. They are characterized by integrated circuits connected

together on a printed circuit board. Minicomputers have higher performance than microcomputers, with richer instruction sets, and a proliferation of high-level languages, operating systems, and networking methodologies.

Microcomputers, also known as personal computers or home computers, refer to complete tiny computing systems. The "heart and brain" of the microcomputer is the microprocessor chip. The chip is a tiny, thick slice of semiconductor material made of chemically treated silicon. Typically, a chip is small enough to fit on a person's fingernail, yet contains thousands of microscopic switching circuits that conduct electricity and process information. Although somewhat similar to the minicomputer, microcomputers differ in price, size, speed and computing power. In addition to the microcomputer itself, a variety of secondary or "peripheral" equipment expands its capabilities and can make input and output arrangements compatible with user needs. Microcomputers can be connected to one another or "networked" by means of telephone transmission.

Instructions for the computer are called programs, software, or in the case of instructional programs, course-ware. Binary code (0's and 1's) is actually used by the computer, and early programmers had to work with "strings" of this code. However, computer languages have been developed that allow a symbol or word to stand for one or more groupings (bytes) of binary code. The most familiar language to microcomputer users is BASIC, which is actually a family of languages since it has several versions. Instruction in programming using BASIC may be considered only an introduction because several recently-developed languages as LOGO, SMALL TALK, LISP, and FORTH promise easier use and greater flexibility. Some of the higher languages available for microcomputers and main-frame computers include: COBOL, FORTRAN, PASCAL, and PL-1.

The major educational uses of computers are:

. Computer-Assisted Instruction (CAI) - an on-line, interactive process between learner and computerized delivery system in which the computer assumes a direct instructional role. The major types/methods of inter-

active computer instruction are: drill and practice, tutorial, simulation modeling, problem analysis and instructional games. The term "Computer Literacy" generally embraces these methods of instruction plus a basic awareness of the computer's potential.

- Computer-Managed Instruction (CMI) - a computerized method of testing, record-keeping and decision making that supports the instructional system and provides diagnostic feedback on student performance; and
- Computer-Based Education (CBE) - a computerized educational delivery system. The hardware and software in an educational environment provide instruction, testing, record keeping, and information resources.

Robert Taylor of Teachers College Columbia University identifies another classification of educational computer usage in his book, The Computer in the School: Tutor, Tool, Tutee. He suggests that as a tutor, the computer teaches its user. In this mode the computer is intended to complement the classroom teacher, not replace that teacher. As a tool, the computer provides a wide variety of services including preparing payrolls, managing library records, and administering/evaluating tests. As a tutee, the computer is taught by a person how to function as a tool and a tutor via the writing of programs.

Two recent surveys help to gauge the extent of computer use in schools. The first, conducted in October, 1980 under the auspices of the National Center for Educational Statistics, provided the following information: of the 15,834 U.S. school districts, 48% provided students with access to at least one microcomputer or computer terminal. At that time, there was a combined total of 52,000 microcomputers and terminals available to students for instructional purposes. Of those districts that did not offer computer capability, 18% planned to implement usage within three years. Most of these were school districts with student populations under 2,500.

A second survey effort, conducted by Market Data Retrieval of Westport, Connecticut during the summer of 1981, contacted representatives of 15,442 school

districts. This survey found that among small school districts (under 1,200 students) fewer than one in three had microcomputer facilities, while in larger school districts (over 5,000 students) two of three had microcomputer facilities.

At the present time, conservative estimates suggest there are at least 100,000 computers in use in schools across the nation. Market researchers predict that total will grow to 270,000 units by 1985.

Computers used for instruction, however, are no better than the materials they contain. While there have been great gains in computer hardware development, similar gains have not occurred in software or courseware development. Hence, buyers of education programs should be careful and selective since much of what is offered for sale is not useful in the classroom. Presently, many educational organizations are attempting to monitor computer-based instructional materials in an effort to provide quality-assurance.

The conduct of our investigation would suggest far greater usage of computers than all other technologies combined; we were literally deluged with nominations of computer projects. Eight computer projects were reported in the Guide. Some of those projects are highlighted as follows:

. One of the oldest on-going computer projects identified was located in Minnesota. As of 1981-82, it had completed its fifth year of computer usage for instruction. This project utilizes a microcomputer center to study the feasibility of microcomputer usage for school management, computer-assisted instruction, computer literacy, computer programming, and community service. The district currently owns 35 microcomputers and 10 terminals or approximately one for each 19 students.

. A Delaware computer project is based entirely on a statewide time-sharing system providing computer-assisted instruction in reading and language arts. The long-range goal of this project is to provide computer capacity such that every

student will have one hour per day of computer usage by 1998.

. In Arkansas, computer-based typesetting is enabling students in grades 9-12 to publish a community weekly newspaper as a School-Based Development Enterprise. This represents the first newspaper the community has had in over sixty years. Students receive credit in creative writing as part of their involvement in publishing activities.

. A three-pronged computer program has been developed in an Indiana school district. A nine-week computer literacy course is offered for all seventh grade students; an independent study program for beginning and advanced programming is offered to all students; and a teacher-training program on use, programming and implementation of computer education is provided. Well over half of the staff members have participated in the training and are using computers in their classrooms.

. An Oregon school district has developed a coordinated junior-senior high school electronics-computer program. Presently completing its fifth year, the program prepares students who complete the sequence to enter either community college electronics-computer courses or the local electronics-computer industries' training programs at an advanced level. The proximity of a number of large electronic companies to this school district has provided career relevance for this program.

. Video Technologies

A distinction may be made between educational television, which is currently widespread, and instructional television. Educational television usually refers to any type of program aimed at informing its viewers. Educational television programs frequently appear on commercial channels as special reports and documentaries. Educational television programming is also made available on the National Educational Television network.

Instructional television, on the other hand, generally refers to a program

designed to track specific subject matter as part of a formal course of study. (In this sense, we examined only utilization of instructional television.) Instructional television, in turn, may have one-way or two-way transmission.

When small or localized audiences are to be reached, one-way instructional television may be an appropriate mechanism. This approach has been used regularly by institutions of higher education to provide graduate education to professionals located at plant or office sites. Several large consortia have also utilized one-way instructional television to provide programming for elementary and secondary classes, special needs students, and teacher inservice. The recent availability of satellite-based delivery systems for education has been used by such groups as the Appalachian Community Service Network. The network currently offers 65 hours per week of college courses, adult education and seminars.

Two-way instructional television systems are presently available and in operation, although some might consider this approach to be still in the experimental stages. Early users of two-way television mechanisms were located in Redding, Pennsylvania and Irvine, California; presently three mid-western sites are utilizing two-way instructional television in multi-district configurations. The sites are utilizing three different transmission modes as follows: low-power television and microwave; cable and microwave; and microwave only.

Videotape and videodisc are media for storing and playing video materials. Each videotape recorder is known by the size tape it uses and the tape configuration. There are five different tape sizes: 2-inch, 1-inch, 3/4-inch, 1/2-inch, and 1/4-inch tape. Examples of tape configurations (which refers to the packaging) are: reel to reel or open reel, video-cassette, and videocartridge. The equipment associated with videotapes is as follows: videocassette player (VCP) - a machine that plays but does not record videocassettes; videocassette recorder (VCR) - a machine that can record and play videocassettes; videotape player (VTP) - a machine

that can play but does not record videotapes; and videotape recorder (VTR) - a machine that can record and play a videotape.

The videodisc is the newer medium for storing and playing video materials. The disc is similar in appearance to a long playing record. A single side of the disc stores 54,000 frames or pictures, or approximately 30 minutes of viewing. The videodisc has two independent audio tracks to allow two levels of audio presentation.

Videodiscs presently exist in two basic types: 1) capacitance, which uses a special stylus tracking arm to sense the disc information, and 2) optical, which uses a laser beam to recover electronically uncoded information and therefore is considerably less subject to wear.

Videodiscs present very distinct advantages, but they have disadvantages as well. The major advantages are: 1) discs store a great deal of information in a small amount of space; 2) discs are ideal for random access; 3) large quantities of discs are inexpensive to duplicate; and 4) some discs can be played at various speeds, even backwards, and can hold "stills" for extended periods of time. The disadvantages are: 1) disc player equipment is not standardized; and 2) the discs must be produced (pressed) and duplicated by commercial firms.

Interactive video or computer-assisted video instruction is a new application of two already existent technologies. It is possible to use the videodisc or videotape in a dynamically-programmed format with the microcomputer. Until the present time, microcomputer courseware has included text, computer graphics, and occasionally, with difficulty, sound. Merging the capabilities of the videotape or videodisc with the computer provides the best of both technologies, the full color and sound of the video plus the learner control provided by the computer.

In order to utilize this capability the following equipment is needed: a microcomputer, a video recorder, a video monitor, and an interface board to connect

the computer and the recorder. Several research and development projects are underway, including some educational applications at Utah State University. The Minnesota Educational Computing Consortium (MECC) has developed an economics course in this medium. An anticipated joint project between two Minnesota school districts (one with a microcomputer project and one with a videodisc development) in 1982-83 will hopefully further develop and test interactive video.

The following are brief summaries of interesting projects, using video technologies, identified in the course of the investigation:

- Iowa, Minnesota, and Wisconsin have multi-district projects utilizing two-way instructional television. Each of these projects has been operational for one to two school years and each has experienced modest successes, most notably, curriculum expansion for senior high school students. The problems encountered have been largely "people" problems, particularly teacher anxiety over broadcast teaching, although equipment related problems have also existed.
- In Illinois, a student built satellite receiving station is being used to receive video materials and make them available to eight area high schools either "on the air" or videotaped for supplemental classroom usage. Users estimate that the availability of resource materials has multiplied fifty times with the advent of the station. Because the station was built with used components and volunteer time it cost approximately $4,000.
- The Letter Shop, a state validated project in Indiana designed to help kindergarten and first grade students develop pre-reading skills, utilizes 32 half-hour videotapes. The materials are presently used in 65 Indiana school districts; the project is in its seventh year.
- Students in "Media Now" classes use a variety of technologies including radio, television, videotapes, audio-tapes, films and slides. Media Now is a production-centered laboratory course of study in mass-media that has been approved for nationwide dissemination by the Federal Joint Dissemination Review Panel. Two exemplary users of the packaged course were identified in Iowa and California.

PRACTITIONER OBSERVATIONS: PLANNING, IMPLEMENTING AND MAINTAINING THE UTILIZATION OF TECHNOLOGY(S)

A number of observations were made, in the course of our inquiries, by practitioners in rural schools, relating to planning, implementing and maintaining the utilization of technology(s). These observations have been summarized under the following topics: Board and Administrative Perspectives; Teacher Involvement; Student Acceptance and Instructional Effectiveness; and Cost Factors. A brief summary of recommendations follows these observations.

. Board and Administrative Perspectives

The following observations have been made relating to school board and administrative perspectives regarding technology utilization:

- . Technology utilization may provide a rural school greater flexibility in curricular offerings and has the potential for improving the quality of education in the rural school district.
- . Technology has been the basis of cooperative arrangements between/among a number of school districts, offering together what one rural school district could not afford alone.
- . Technology may help in overcoming distance and transportation barriers and costs in rural areas, as well as barriers related to weather conditions for travel. Thus, students do not need to be transported as frequently.
- . Technology may ease the need for some teacher layoffs (e.g., ability to maintain a Spanish teacher if shared with other districts utilizing instructional technology).
- . Technology may help alleviate the need for consolidation among rural schools.
- . Major problems in utilizing technology, common among all schools, but magnified in small and rural schools, appear to be:

- Money for hardware/software;
- Staff development;
- Communications among developers and potential users;
- Confusion (and some differential pricing) caused by myriads of vendors/salespersons in the field;
- Lack of follow-up (servicing) by vendors/sales organizations, following installation;
- The existence of many well-composed programs that are poorly-suited to classroom use or integration with existing curricula; and
- Publicity efforts relating to new technologies which generate inquiries and result in additional time and expense for project operators, thus possibly detracting from the day-to-day effectiveness and efficiency of the projects.

. Teacher Involvement

The following observations have been made relating to teacher involvement in technology utilization:

. Teacher-initiated utilization of technology(s) usually experience easier acceptance patterns than administratively-initiated utilizations. Teachers need to be involved in the planning and developmental processes, regardless who has initiated the utilization.

. Technology can be utilized effectively to supplement, not to supplant the teaching efforts of teachers. Even with the use of technology (e.g. two-way television) there is still a need for student and teacher to "meet first hand," at least occasionally.

. Use of new technologies must be "sold" to all school district persons, but particularly to adults (who have been educated in a "no hands-on" era) in order to overcome fears of technology.

. Some teachers may resist technology utilization; teacher training/re-training is necessary, and needs to be a greater priority with teacher trainers.

. Local enthusiasm in implementation and continuation of technology utilization is often due to the efforts of one individual teacher advocate. Administrative and Board advocacies are also helpful.

. Some questions teachers ask include:

- *Is technology usage instructional (i.e. in the mainstream) or is it an appendage?*
- *Does technology create a lack of interaction between the teacher and student?*
- *Are educators using technology as a "quick fix" rather than searching for quality as a permanent solution?*

. Student Acceptance and Instructional Effectiveness

Student acceptance and instructional effectiveness is the "bottom line" relating to the utilization of technology(s) in rural schools. The following observations are associated with these areas:

. Technology may be most successful when used with students at the two ends of the high/low achievement scale. Technologies are being used successfully with special needs students, including the gifted.

. Technology utilization may be more effective and more easily accepted when it is made available in the classroom, rather than as a "pull out" activity.

. Technology has made it possible for rural school districts or groups of districts to provide curricular offerings to students which were not available prior to its utilization on a "shared basis."

. Concrete, "hands on" evidence of technology utilization will usually result in a higher degree of student feedback and parent acceptance. An example is a (hard copy) computer printout which a student can take home to share with parents.

. Career and occupational implications of technology utilization (e.g., computer programming and its job-placement potential) are directly related

to parent and student acceptance.

. The functionality and workability of the technology should be checked out and confirmed before it is linked into the instructional process(es). Failure to do this may lead to frustration and lack of confidence in the technology.

. Generally, student discipline in a learning/technology situation has been no more (and often is less) of a problem than exists in more traditional learning situations.

. Generally, students enjoy their use of technology(s) in learning and believe that they learn and retain as much or more than they do in other (traditional) modes of instruction. Student testing, to date, (with experimental and control groups) tends to confirm this observation.

. Cost Factors

The following observations have been made relating to costs and cost factors in technology utilization:

. "Front-end" costs associated with the capitalization of instructional technology hardware (and some software) are the greatest share of total costs. Rental of telecommunications lines is also a major cost. (The potential for higher costs of rental lines appears to be increasing.)

. Ongoing costs are difficult to predict, since much of the equipment is new and its actual "useful life" and "track record" have not yet been determined. Longevity of equipment is yet to be determined in many instances.

. Federal and state grants (and some private foundation grants) have played a large part in initial start-ups of technology utilization.

. "Scrounging" of used and surplus equipment, and staff/student efforts in construction, have effected large cost savings in making technologies available in some rural school situations.

. Summary Recommendations

The following Summary Recommendations for the utilization of technology(s) in instruction are based on the observations reported above. They are provided particularly for rural and small school practitioners who might wish to introduce technology applications within the teaching/learning situation, as one means of "moving forward in times of adversity."

* *Remember that technology can be utilized effectively to supplement, not to supplant, the teaching efforts of teachers.*
* *Try to organize and involve an interested and enthusiastic staff group (particularly teachers) in all stages of technology utilization.*
* *Seek to build staff skills in utilizing the technology(s) to be implemented. Support and provide pre-service and in-service sessions and retraining as necessary. This is time and money well spent. Express your needs to teacher trainers and teacher training institutions.*
* *Seek advice from other practitioners utilizing the same technology before adopting/adapting it in your instructional system. Seek the assistance of state and national organizations/agencies dedicated to the utilization of technology, including the vendors and sales organizations.*
* *Be certain to check out the functionality and workability of the technology before linking it to the instructional process. Be certain that it "works," and has a high probability of success.*
* *Seek ways to show "concrete" results in instructional effectiveness and student change as a result of implementing the technology(s). Show how students' involvement with technology can have effects on their future living, including careers and opportunities in the world of work.*
* *Look for ways to communicate and share with practitioners in other schools, both rural and non-rural. These are not good days for "reinventing the wheel".*
* *Try to make available the technology as near to the regular learning situation (e.g. the classroom) as is feasible, rather than as a "pull out" activity.*

* *Avoid fragmentary approaches to curriculum development in introducing technology(s). Try to make the implementation a school-wide, if not a district-wide effort, and a part of orderly curriculum development.*
* *As Wells has so aptly written, "Start small. Build slowly. Incremental growth you can manage; instant sophistication is risky. Success, not glamour, is what counts." (Wells, 1979).*
* *Be prepared to change and to be flexible in any planning, implementation and maintenance strategies you may employ to utilize technology. Technology grows, changes and is not static.*

* * *

Additional resources related to the content of this paper include:

. A Guide on Successful Uses of Technology in Rural Schools, National Institute of Education, Washington, D.C., June, 1982. *(The Guide includes more complete descriptions of projects noted in this paper plus additional interesting projects/programs utilizing technology(s).)*

. Baker, Justine, Microcomputers in the Classroom, Phi Delta Kappan Fastback 179, 1982.

. Grayson, L.P., "New Technologies in Education." Encyclopedia of Educational Research, 5th Edition, 1982.

. Joiner, L., Vensel, G., Ross, J., Silverstein, B., Microcomputers in Education: A Non-Technical Guide to Instructional and School Management Applications. Holmes Beach, Florida: Learning Publications, Inc., 1982. *(Appendices include lists of microcomputer vendors, printers and video displays, peripherals, software sources and software reviews, newsletters, magazines, journals, directories, organizations and resource centers pertaining to microcomputers.)*

. Taylor, Robert P., ed. The Computer in the School: Tutor, Tool, Tutee. New York; Teachers College Press, 1980.

. Wells, R., "Planning and the American Computer Machine." Paper presented at the Harvard Graphics Week Conference, Cambridge, Mass., July, 1979.

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